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Creating the User Experience – The Need of Subjective Knowledge

1. Introduction

The reason for using intelligent, or what seems to be intelligent, software is often to automate boring tasks or to make complicated tasks easier to handle. However, automatic user support when creating complex information systems is seldom given high priority by the industry (see Grudin 1996). The result is that end-users are unable to derive full value or benefit from the application, no matter how "good" or "well designed" it might be. Moreover, it is important that the users have an understanding of the reasoning behind any automatic support tool, i.e. the technology behind the support must be *transparent* to the user in order for him to put trust in the system (Dinka, Nyce and Timpka in press).

This is not only true for the industrial area, but also in more casual situations like home use, user support might not get the attention that it deserves, even if the level of support (and complexity of the application) might not be as high as in the industrial section. Also, the users are seldom the kind of *accidental users* (Marsden and Hollnagel 1996) that would be more common in an industrial setting. Accidental users, as defined by Marsden and Hollnagel, are users that are forced into using information technology when there is no alternative. The use can then be forced to and divided from the task being performed, a task that the user traditionally has been able to do before the information technology was present. In a home environment, the users often have the possibility to choose not to use a certain technology, whereas in professional settings, users have to use certain technology to perform their work task, even if they are not interested in using the information technology.

The support and guides that are desirable for the home environment, and the technology present there, have the goal of replacing boring tasks (e.g. dish washer) or decrease repetitive work and make the interaction more "casual". This indicates that the interest of the users will also differ from the forms of interaction represented by the accidental users and users in professional situations. Aspects that are highly prioritized in a production situation, such as economical aspects or efficiency aspects, might not be as important when interacting with the TV on the couch.

It has also previously been argued that objective measurements of what is usable are not enough to satisfy the users. Instead, it has been shown that it is possible to reach increased usability by making applications more aesthetic and attractive (Tractinsky, Katz and Ikar 2000). But it is more to it than making the interaction beautiful; it is also a more general matter of making the interaction appreciated by the users. As an example, we will discuss some of the findings from the Numpad Typer.

2. The Numpad Typer

The numpad typer (Ingmarsson, Dinka and Zhai 2004) was created in order to make text input to the TV easy and casual. With increasing complexity of TV sets and set top boxes, connection to the Internet and possibilities to write email or instant messaging, the need for easy and fast text input has emerged. The TV-situation has big differences compared to, for example, writing mail at a traditional workstation - differences that make a traditional QWERTY-keyboard harder to use and not very convenient. It is now suitable using a full QWERTY-keyboard sitting in a comfortable chair or sofa, with just a coffee table in front of you. The situation of use is a more relaxed one, compared to sitting on an office chair with an office table. The design of the numpad typer (TNT) was based on some basic rationales:

- Use the existing remote control form factor, with the numeric keypad as the basic input mechanism
- Take advantage of the large color screen space and let the display (feedback and guidance) play a stronger role in the input process.
- Direct the user's visual attention towards the TV screen, not to the remote control device. The method should require minimum attention switching back and forth between the screen and remote control.
- Given the application domain, novice users should be able to use the input method easily without much practice. This means that the method should be conceptually clear to the users.
- The method should also be "expert-friendly". One should be able to pass the initial learning stage and reach a reasonable typing speed, although it is not a requirement to reach the level of full keyboard typing.

These rationales were all from an objective perspective, with little or no attention to the users subjective experience, aspects that we will get back to later on. The resulting design was a result of an iterative exploration based on these rationales. TNT works by letting the user press two numeric keys to produce a letter on the screen. A total of 81 letters, symbols, or commands are laid out on two layers of 3 by 3 grids, spatially corresponding to the 3 column and 3 row numeric keys on the keypad. The first key press selects a group, and the second selects a member in that group. For example, in order to produce the letter "b", the user first

DOI 10.1524/icom.2006.5.2.62

presses 1 on the keypad, selecting the first group of letters (as shown in the figure). Then the user proceeds to press key 2 on the keypad, which selects the corresponding letter "b" in the selected group.

The design of TNT has many characteristics considered as key aspects in the traditional HCI literature, such as visual guidance and visual feedback (made visual by the yellow color in figure 1 and 2). But also stimuli-response (S-R) compatibility (Fitts and Seeger 1954) and consistency (Schneider and Shiffrin 1977) are well represented. The S-R compatibility is presented in the way that the inputs made on the remote control (Figure 1) correspond to the same actions shown on the screen. In this case, pressing the number 1 keypad, on the upper left position, will highlight the upper left position on the screen. The consistency derives from the fact that even if every letter takes two key strokes, it is always the same keystrokes, writing "a" is always pressing 1 – 1, writing "r" is always 2 – 9 and so on. It has also a logical alphabetical layout, in the sense that the letters are alphabetically ordered, first in three groups of letters and then by individual letters in a group.

2.1 Test Set-Up

The experiment was designed as follows: Five paid volunteers were recruited to participate in ten sessions of Swedish text entry with TNT. The five participants, two female and three male (27 to 32 years old) had different backgrounds as regards work and education. All the participants were familiar with the use of a QWERTY-keyboard and they had also tried the T9 system on their own mobile phones. Each experiment session took 45 minutes. During the session, the participants continuously write text using the system. The same text was used throughout all sessions and the participants started out from the beginning each time. The text used was a Swedish novel "Macurells i Wadköping", and the participants had this text on the TV as well as the visual representation of TNT. The text used was preferred, instead of using random letters or words, for a number of reasons. First, we wanted the situation to reflect real language use. An approach constructed in order not to bore the participants. Second, the improvement made by the user became visible to the user in the way that s/he sees were s/he passes the previous result within the same time duration, increasing the motivation to get better in each session. The experiment started with an experimenter explaining the task and the system to the participants, together with a short demonstration. It was explained to the participants that the purpose of the experiment was to test and evaluate the TNT method, not their ability. The participants were also instructed to focus on the concept and not on specific UI issues when given their subjective evaluation. As an incentive, the person with the highest speed would receive a $50 cash reward in addition to the $8 they received as compensation for each session.

The participants were instructed to write as fast as possible, using one finger, with as few errors as possible. The test-system only accepted correct characters (characters that correspond to the text written), so there was an implicit delay in form of lost keystrokes if a wrong letter was entered, which in turn discouraged the participants from making errors.

If an error (a wrong character) was typed, the system would recognize this and store the event in a log-file. Also, every key typed was timed and stored. Together with the error rate, this made it possible to decide words per minute (WPM). The measurement of WPM made it possible to follow up and relate this

1	2	3
4	5	6
7	8	9

Figure 1: The remote control

method to other text input methods such as T9.

After each session, in order to not disturb the actual performance, there was an interview with the participants to capture the spontaneous reactions. (Hackos 1998) After the final session, there was also a longer, in-depth interview with the participants. The use of an in-depth interview was motivated by a desire to get a higher resolution of opinions and a less restricted set of answers from the test subjects. This was also motivated by a desire to find out the reasoning behind the user's opinion. This could, in our opinion, be hard to reach with quantitative questionnaires measuring subjective data. These interviews were done in the same physical area where the test has been performed, so the users could point and show on both the screen and the remote control if they wanted to explain anything particular. The constructions of

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Figure 2: The visualization on the TV-screen

the interviews were open-structured, touching on specific themes. By using interviews, there was a possibility to reach beyond the quantitative performance, and get an indication what the users felt about the concept. (Ingmarsson, Dinka and Zhai 2004)

Examples of themes mentioned during the interviews:

- Joy of use
- Ease of use
- Satisfaction of use
- Comparison between TNT and other known technologies
- Graphical representation
- Subjective thought-process when using the tool (e.g. How do you reason when writing a specific letter)
- Cognitive load
- Focus shifts (from remote to screen and vice versa)
- Areas of improvements
- Overall impression

3. Results of TNT

The performance of TNT in terms of speed is comparable with, even if not as high as some, other text input methods with the same focus and ranging from 9.3 words per minute in the first session and up to 17.7 words per minute in later sessions. After seven sessions, the learning curve (and thereby the visible improvements) started to flatten out (Figure 3). (A more detailed description of the statistics from the testing can be found in Ingmarsson, Dinka and Zhai 2004).

The important aspects of this, as related to the issues discussed in this paper, are that the speed was not extremely fast, neither extremely slow in relation to comparable technologies. For a traditional QWERTY-keyboard, words per minute (WPM) from a regular user is about 30 (Karat, Halversion, Horn, Karat 1999), Graffiti and Jot (two of the most common text input techniques is 4.3-7.7 (up to 14-18 WPM for advanced users) (Sears, Arora 2002). It should be acknowledged that by using QWERTY-keyboards, every key press corresponds to one letter, where in the case of TNT it takes two. Also, the user has the possibility to use all ten fingers when using QWERTY, and only one when using TNT. Consequently, the speed of TNT is, in relation to key presses and number of fingers used, comparable with QWERTY.

There might be an area of improvement regarding efficiency, for instance by optimizing the organization according to Fitt's law or alike (Zhai, Sue and Accot 2002). In short, it is possible to re-arrange the letters in order to use keys that are harder to reach (i.e. 9) less often (keys closer to the thumb turned out to be slightly harder to reach).

However, the focus here is on the subjective experience of TNT and how the users felt about the concept. The goal was to get qualitative descriptions (Kvale 1996) of the concept and having these descriptions would make it possible for us as scientists to interpret the user experience.

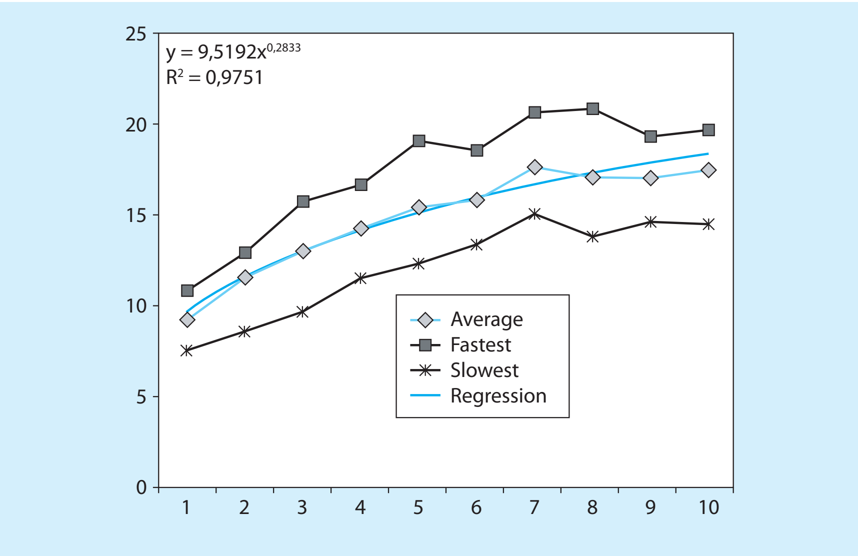

Figure 3: Chart from Ingmarsson, Dinka and Zhai 2004 showing wpm over the 10 sessions

3.1 User Reactions

The users tend to compare TNT with more familiar text input methods such as T9 or QWERTY layout. TNT was described as being easy to understand and use. The learning period was also experienced as fast, and after half of the first session, all the participants felt that they did not need to think about the concept any longer. Instead, they focussed on how to write faster and finding letters that were less common. The experienced short learning period made the users feel that the methods was fun to use and encouraged them to write faster.

"It feels more easy to use (than the T9), since it is more logical. Changing the physical positions would take away the logical structure, so that is not desirable." [User 1]

"It is quite fun to use, since the actual concept was easy to grasp the interaction almost became transparent…" [User 2]

They were even surprised with their performance in a later session, a performance that exceeded their early expectations.

"The first time, it was a quite big (cognitive) load, when you try to memorize the combinations. Later, the (cognitive) load was very small, smaller than using (text input in) the mobile phone" [User 3]

Compared to the T9, one participant described the TNT as less frustrating since the behavior made it easier to focus on the text written rather than the mode the button is in. Another participant described that he felt that he had "control" over the tool and that the subjective feeling was that he was better than the actual words per minute, even if he never felt that he would be as fast as when writing with a QWERTY-keyboard. Other participants also described the interaction as being more fun, especially when they could concentrate on the text after some experience and did not have to shift focus between the keyboard and the screen (mostly after the second session). The fast learning also challenged the users to be faster, since they did not need to concentrate on the tool, they could focus on trying to beat their previous results in speed.

"After a while, I could focus more on writing faster, and less on remembering

the positions. I started competing with myself." [User 2]

The drawback of the system, as described by the participants, was that the method never felt to be as efficient or fast as a regular QWERTY-keyboard.

"It sometimes felt kind of 'artificial' using a remote control as the tool for text input, sometimes I was able to write faster than the remote could register…" [User 3]

However, since the system was not seen as a tool for writing longer texts. This was not considered as a big problem. The short learning curves also made the users down prioritize speed as a feature.

4. Conclusions

The subjective evaluation based on post-test interviews showed that TNT was "fun to use" and "easy to learn" due to a clear conceptual model of the TNT design. Even if other, more efficient, text input methods were known, the participants tended to rank the TNT higher on these subjectively experienced premises. This suggests that fun interaction make the need for efficiency (and intelligence) less important. Also, relating to the professional setting, research has shown that aspects such as trust and transparency can also form the interaction and also change the way the users perceive their tasks. (Dinka, Nyce, Timpka, in press) This, also being a subjective approach towards the interaction, strengthens the idea of treating subjective experience as an important aspect in relation to traditional and objective HCI measurements, i.e. speed and efficiency was not the driving force for the users to approve and like the tool. Instead, fun of use and challenges built in were considered as criteria important for them when using text input methodologies.

Interfaces that challenge and inspire the user, but do not frustrate the user with hard learning or high complexity is, as shown, likely to create a positive user experience. Also, putting the user experience in focus will help the designers to create tools and methods that have a greater possibility in gaining the trust of the users.

These findings, together with previous findings (i.e. Tractinsky, Katz and Ikar 2000), show the importance of taking subjective experience into the account when doing usability evaluations, especially when talking about consumer products. When it comes to professional applications, the subjective experience will be important, but for other reasons. As shown in Dinka, Nyce and Timpka (in press 2005), the identity of the users and how the identity is built up by history (of use, education, etc.) forms the current interaction in the way that users will approach and use technology in relation to their identity. That means, the subject experience does not only influence the perception of the technology, it also forms the very definition of the task being preformed. This does not mean, of course, that the objective-oriented interaction design is of no importance. It does however mean that interaction design must treat the individual and subjective experience as equally important as more objectively measured usability.

Literature

Beyer, H.; Holtzblatt, K.: *Contextual Design – Defining Customer Centered Systems.* Academic Press. San Diego, US. (1999)

Bødker, S.: *Through the interface: A human activity approach to user interface design.* Hillsdale, NJ: Lawrence Erlbaum Associates (1990)

Dinka, D.; Nyce, J.M.; Timpka, T.: *The Need for Transparency and Rationale in Automated Systems.* Interacting with Computers. In Press.

Dinka, D.; Nyce, J.M.; Timpka, T.: GammaKnife Surgery: Safety and the identity of users. *Journal of Technology and Health Care* **13** (2005) 1–11.

Fitts, P.M.; Seeger, C.M.: S-R Compatibility: spatial characteristics of stimulus and response codes. *Journal of experimental psychology* **46** (1954) 199–210

Grudin, J.: The Organizational Contexts of Development and use. *ACM Computing Surveys* **28** (1) (1996) 169–171.

Hackos, J.; Redish, J.: *User and task analysis for interface design*. Wiley & Sons, Inc., New York, 1998

Höök, K.: Steps to take before IUIs become real. *Journal of Interacting with Computers* **12**, no. 4, pp. 409 426, February 2000.

Ingmarsson, M.; Dinka, D.; Zhai, S.: TNT- A Numeric Keypad Based Text Input Method. *CHI 2004*, 24–29 April, Vienna, Austria.

Karat, C.M., Halverson, C., Horn, D., Karat, K.: Patterns of entry and correction in large vocabulary continuous speech recognition systems. In: *Proc. CHI'99 ACM Conference on Huyman Factors in Computing Systems*. (1999), ACM, 568–574

Kvale, S.: *Interviews: Introduction to qualitative research interviewing*. Sage Publications, Inc., 1996.

Tractomslu. N.; Katz, A.S.; Ikar, D.: What is beautiful is usable. *Interacting with computers* **13** (2000) 127–145.

Marsden, P.; Hollnagel, E.: Human Interaction With Technology: The Accidental User. *Acta Psychological* **91** (1996) 345–358.

Schneider, W.; Shiffrin, R.M.; Controlled and automatic human information processing: Detection, search, and attention. *Psychological review* **84** (1) (1977) 1–66

Sears, A., Arora, R.: Data entry for mobile devices: An empirical comparison of novice performance with Jot and Graffiti. *Interacting with Computers* **14** (5) (2002) 413–433.

Zhai, S.; Sue, A.; Accot, J.: Movement Model, Hits Distribution and Learning in Virtual Keyboarding. In: *Proceedings of CHI: ACM Conference on Human Factors in Computing Systems* (2002) 17–24.


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